ward the hurricane track recurves with them. On the other hand the hurricane itself disappears in higher latitudes and is transformed into a shallow cyclone, because there the countercurrent flow in the higher levels ceases. These conclusions can be further illustrated by reference to Charts XIV A, XIV B, and XIV C, mentioned above.

APPROXIMATE NORMAL CIRCULATION IN THE WEST INDIES DURING THE WINTER AND SUMMER, RESPECTIVELY.

On Charts XIV A, XIV B, XIV C, figs. 44 to 61, which show the average normal circulation in the West Indian district of the Tropics, special attention is directed to the vectors in the four upper levels—alto-stratus, cirro-cumulus, cirro-stratus, and cirrus—for the summer months, figs. 44 to 52. These charts were drawn by inspecting all the available data from the eleven stations and carefully determining the most probable mean vectors that would make a natural, well-balanced system, wherein irregularities due to imperfect observations would be rectified. A comparison with the vectors of Charts XII A, XII B, and XII C, shows that the changes which have been introduced are all of a minor nature, and it is supposed that a larger number of observations with the nephoscopes would produce a system of vectors very closely approximating those here adopted. In the lower levels, from the surface wind up to and including the alto-cumulus level, the currents are similar, except that in the strato-cumulus level the velocity is at a maximum. From this level it diminishes both upward and downward.

It should be remembered that in discussing the nephoscope observations of 1896–97 for the strictly cyclonic and anticyclonic components in the circulation of the middle latitudes, we reached the same result regarding the prevailing level of maximum velocity, namely, that the maximum velocity is in the strato-cumulus level. Compare chart 68, page 625, Report of the Chief of the Weather Bureau, 1898–99, Vol. II.

In the upper levels of the Tropics, on the other hand, a new circulation is prevailing, which is peculiarly interesting in connection with the causes that generate hurricanes. Instead of one single westward drift, as in the five lower levels, there exist two countercurrents in the four upper levels. The western group of stations—Havana, Cienfuegos, Santiago, and Kingston—have their vectors pointing southward; the eastern group of stations—that is, Santo Domingo, San Juan, Basseterre, Roseau, Bridgetown, Port of Spain, and Willemstad—have vectors pointing generally northward. Between them there is a distinct region of counterflow, and, consequently, an area of low pressure. If we assume that in the upper strata, where the mechanical friction is a very small quantity, and where the internal mixing from local minor cyclones is negligible, the vectors are directed nearly parallel to the isobars, then we can easily construct their configuration, though we can not assign numerical values to them without further investigations. On the eastern side there is a high area, which is a portion of the western end of the prevailing Atlantic high pressure. On the western side there is another high pressure area, whose origin is not so easy to understand. Over the North American Continent in summer the heated surface conditions produce a general low pressure area in the lower strata, and simultaneously a high pressure area in the upper strata. It is very likely that the western high pressure in the upper strata over the West Indies is really the southern extension of the continental high pressure area prevailing in summer over the United States. Some further computations on our nephoscope observations in the United States will be required to determine the exact facts.

Between these two high pressure areas in the West Indies there exists a low pressure area, with countercurrents on either side, so that all the conditions are present that are needed to produce a *cyclone in the upper strata*. If the prevailing pressures and currents become intensified at any time, the high-level cyclone is strengthened, and it then penetrates with its large vortex tube to the surface as a regular hurricane. The entire circulating structure is borne along northwestward in the prevailing drift of the *lower* levels till it recurves in the southeastern part of the United States. It is evident that the locality of the formation of the center of cyclonic motion may shift eastward and westward over the West Indian region, depending upon the state of the atmosphere at the time, the position of the two great high pressure areas, and the conflicting currents in action. The normal type here produced is in reality made up of numerous fluctuations on either side of the mean. In forecasting for hurricane conditions it becomes necessary to watch carefully the motions of the four upper cloud levels, in order to learn the practical signs foreshadowing such a hurricane condition.

On Charts XIV B, XIV C, figs. 53 to 61, "Normal vectors for winter," the interest is of a different character from that explained in connection with the summer type. Here it is the reversal from the westward drift of the lower strata to the eastward drift of the upper strata. From the surface up to and including the strato-cumulus level the configuration is generally the same throughout the West Indian region, Then the reversal vectors first set in at the western stations, Havana, Cienfuegos, Santiago, in the alto-cumulus and alto-stratus levels; the other stations become involved later in the higher cirro-cumulus, cirro-stratus, and cirrus levels, where the regular antitrades prevail. The azimuths of the higher vectors show that the northward component nearly vanishes in the cirrus level over the eastern stations. It will be necessary for meteorologists to outline the eastern portions of the Atlantic high area in the levels up to 6 miles before executing conclusive discussions of the important dynamic problems suggested by these vectors.

THE MEASUREMENT AND UTILIZATION OF FOG.

By Percy Leonard, dated Point Loma Homestead, San Diego, Cal., April 12, 1904.

Seeing that the prevalence of fog here in the early summer is a very great help to vegetation, but that only a very small part of this gets into the rain gage, it seems a pity that our climate does not get the credit of this moisture in the precipitation records. Why should not an instrument be made, to imitate, to some extent at least, the action of the leaves and twigs of trees, and arrest the passing fog particles and make them render an account of themselves in the measuring tube?

I would suggest a wire framework of the same area as the rain gage, and say one foot high and made to fit on the rain gage. This wire-work cylinder to be crossed and recrossed with some durable filaments (e. g. horsehair) dividing up the cubic content into cubes of one-half an inch or less.

From a day of drifting fog I am convinced a great deal of water would be intercepted and deposited in the measuring tube.

Perhaps it might not answer to make the fog depositor a permanent extension of the rain gage, as it might interfere with its function as a measurer of legitimate rainfall. In this case perhaps it might form a separate instrument and its data be entered in a column by themselves.

A simple cylinder of very fine meshed wire gage of the same diameter as the rain gage to fit on the top might be better than the horsehair-crossed space, because I imagine that this would not interfere at all with its functions as a rain gage pure and simple.

If such fog depositors were used throughout the country the comparison of the returns would be interesting, and this much abused "arid section" so called, would make a very respectable showing of fog deposit that would level up to an appreciable degree its total precipitation to that of districts with a larger rainfall.

It must occur to everyone who reads the above article that the proposed wire screen to catch the fog is not an exact equivalent to the leaves and twigs of a given plant, and the relation between the catch of the screen and the catch of the natural plant must be an entirely uncertain matter, unless we can first, by special investigation, determine the ratio of the catches in the two cases. Moreover, this ratio must necessarily be an extremely variable quantity, depending on the velocity of the wind at the two locations and on the variations in the leaf surface as it increases and diminishes with the phenological season. Moreover, the surface will vary from year to year as the plant increases in size. It would, therefore, be difficult, if not impossible, to argue from the catch of a screen up to the catch of an orchard of trees. The rain gage tells us that there has been a half inch of rainfall during a dry month in the shape of drops that descended with sufficient rapidity and in sufficient quantity to sink into and really wet the soil, so that the roots of the plants could absorb the water. On the other hand this "fog depositor" simply tells us how much it collected, and gives no positive information as to how much the leaves and stems collected or how much of the water fell to the ground in such a shape and such a place that the roots could utilize it.

In the MONTHLY WEATHER REVIEW for October, 1898, and March, 1899, will be found several notes on the utilization of fog, but nothing that aspires to be called the measurement of the quantity of fog, such as is suggested in the above communication from Mr. Leonard. From these articles it will be abundantly evident that the fog may be gathered and made useful to the plant, not so much by a system of horizontal wires or wire network, as by a system of inclined wires, rods, or stocks, each of which serves to lead the fog as fast as collected directly down to that part of the ground where the roots of the plants most need it; in fact, down to the bottom of holes in the ground where the water will be absorbed and stored up for the use of the plant, safely protected from evaporation by the heat of the sun and the strong dry winds. If a field be covered with a system of such devices, each serving to furnish water for a special tree, then one such device, considered as a type of all, instead of watering a tree could be attached to a measuring apparatus, and we should thus know to what extent we were utilizing the fog, apart from the action of the tree itself. In fact, if one wishes, the drip from a given tree may also be measured, in order to know the relative value of the tree and the apparatus as collectors of fog.

It is much more important to stimulate the invention of apparatus to catch the fog and help the tree than it is to establish fog depositors and utilize their records in making up a respectable showing of total precipitation for the arid region. Over the whole world we find both arid regions, and plants that can be cultivated therein. Everyone knows that fog and dew are helpful in such regions. The main question is how to make the best use of them. It is, perhaps, a popular error to imagine that the dewdrops on the leaves are utilized directly by the latter. But we believe it has long since been definitely settled that aqueous vapor evaporates from the leaves and is not absorbed by them. The raindrops, dewdrops, and fog must be carried to the finest roots themselves and be absorbed by them before the water can become a part of the sap and the life of the plant. A foggy atmosphere represents a saturated or nearly saturated condition, such that the atmosphere, flowing by the leaf, does not stimulate evaporation from the leaf, but tends powerfully to the concentration of the moisture within. A too rapid evaporation from the leaf wastes the sap.

The cellular growth of the plant is a relatively slow process, and can not be greatly stimulated without injury to the resulting fruit or other products. But it may be greatly retarded by the scarcity of sap and the increased viscidity of this liquid, produced by an evaporation from the leaf more rapid than the sap can be supplied by the roots. This is shown by the limp and flaccid condition of the tender, green parts of plants under midday sun and dry wind, as compared with the coolness and dew or fog of the moist air during the nighttime. We apprehend that the benefits accruing to delicate plants from the presence of the daily fogs on the California coast result not so much from the drip of the fog caught by the leaves as from the protection offered by the fog against the burning sun's rays. In other countries we have seen similar protection offered by a thin layer of clouds, and in still others the injurious effect of the direct heat of the sun is greatly tempered by the cooling action of a very strong sea breeze.

THE FORMATION OF SNOW IN CLOUDLESS AIR NEAR THE GROUND.

By J. N. WEED, dated Newburgh, N. Y., May 16, 1904.

January 5, 1904, was an extremely cold day. The temperature ranged from 5° to 19° F. below zero.

Within a radius of 15 miles about the city some temperatures as low as —40° were registered. It was notably colder outside of the city than within.

For several hours in the middle of the day there was a gentle and continuous fall of snow flakes, forming about 40 feet above the surface in the middle portion of the street, and slowly falling (with a 10° deviation from the vertical, about,) and gradually increasing in size as they fell. The sky was clear and the air calm.

I went upon the roof to see if the snow was falling there or could be discovered in the air above. It was found to be confined to the street below the tops of the buildings. The windows were decorated with frostwork, showing the presence of vapor in the buildings at least. The street extends north and south parallel with the Hudson River, and is, say, about 25 feet higher and 300 feet distant.

Earlier in the morning there had been a fog haziness upon the water, limiting vision near the surface to half a mile, but this soon cleared away.

Can not an explanation of the snowfall be found in the very low temperature, in the excessive artificial heating of the buildings (which formed an unbroken row on both sides of the street), in the heating effect of the sun's rays on the sides of the buildings and on the flagged side walks (free of snow while the street proper was covered with ice), and last but not least by the escape of the moist, heated, dusty air of the buildings every time an ingress or egress took place? These conditions all tended to induce a rising current on the sides of the street and a falling one in the middle thereof. The rising current, on reaching the cornice of the buildings, was deflected outward and into the falling cold current and its vapor condensed.

One thing is absolutely certain: Snowflakes were formed under a cloudless sky, in the middle of the day, within 50 feet of the ground, in the narrow compass of a street but 50 feet wide.

Snow also fell on the following day under the same conditions, except a moderated temperature; less abundantly, however.

THE ENERGY IN A UNIT OF LIGHT.

By E. BUCKINGHAM, dated May, 1904.

Das mechanische Äquivalent der Lichteinheit: von Knut Ångström; Physikalische Zeitschrift *3*, 257, 1902.

Energie dans le Spectre Visible de l'Étalon Hefner: par Knut Ångström; presented to the Royal Society of Sciences of Upsala, May 6, 1903.

The first of these papers is referred to by its author as a "preliminary note," and since it deals with experiments which form an integral part of the research described in the second paper, its contents will be described in this review of the latter paper, and need not be referred to separately.